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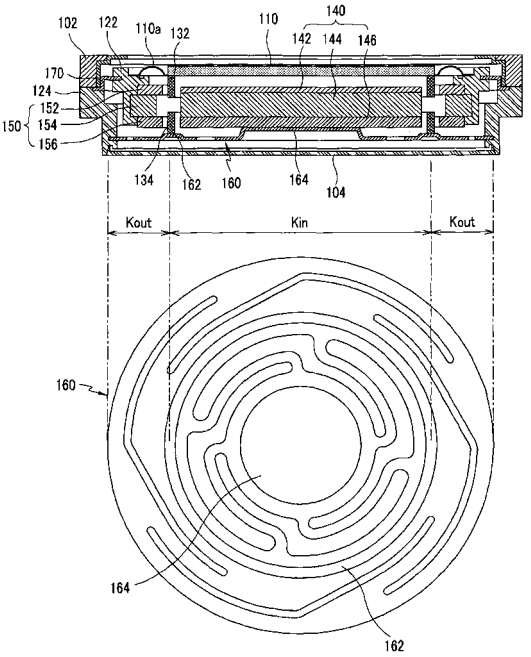
(54) MULTIFUNCTIONAL SPEAKER

(57) Provided is a multi-function speaker, which provides vibration and acoustic functions at the same time. The multi-function speaker includes an internal frame supporting a diaphragm to which a voice coil is attached, a first suspension having stiffnesses different from each other at inside and outside portions thereof to vibrate the inside portion attached to a vibrator and stabilize vibration of the vibrator at the outside portion, an external frame supporting the outside portion of the first suspension, the external frame receiving the internal frame in an inner space thereof, and a second suspension elastically coupling the internal frame to the external frame to buffer a movement of the internal frame. When the vibrator is vibrated, the first suspension prevents abnormal vibration and the second suspension buffers the movement of the internal frame to stabilize an operation of the vibrator in duplicate.

FIG.4



EP 2 268 060 A1

Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a speaker, and more particularly, to a multi-function speaker, which provides vibration and acoustic functions at the same time.

Description of the Related Art

[0002] Generally, speakers are acoustic devices in which an electrical signal is converted into kinetic energy at a magnetic circuit along a voice coil to generate a dilatational wave in air, thereby generating a sound wave. The speakers are widely used for mobile phones or various portable electronics.

[0003] Portable electronics such as a mobile phone includes a vibration module to inform an arrival signal or perform a bone conduction function. To realize miniaturization and cost reduction, multi-function speakers including a vibration function are being developed, and also widely used.

[0004] As shown in FIG. 1, a typical multi-function speaker 10 has a structure in which a diaphragm 11 to which a voice coil 12 is attached, a frame 13 supporting the diaphragm 11, and a vibrator including a plate 15, a magnet 14, and a yoke are supported to the frame 13 by a single suspension 17. According to the typical multi-function speaker 10, when a sound signal is inputted into the voice coil, the diaphragm 11 is vibrated to generate sound. Also, when a vibration signal is inputted, a vibration module is vertically vibrated.

[0005] However, in the typical multi-function speaker 10, unstable vibration (e.g., jumping phenomena, material fatigue properties, and rolling tendency) may be generated due to a single suspension, as well as, abnormal sound or noise may be generated due to an interference of a magnetic system when the vibrator and the diaphragm are vibrated at the same time.

SUMMARY OF THE INVENTION

[0006] Accordingly, the present invention is directed to a multi-function speaker that substantially obviates one or more problems due to limitations and disadvantages of the related art.

[0007] An object of the present invention is to provide a multi-function speaker that prevents abnormal vibration due to a suspension having dual stiffness with stiffnesses different from each other.

[0008] Another object of the present invention is to provide a multi-function speaker in which an internal frame and an external frame are divided to prevent abnormal vibration using a first suspension using a first suspension supporting a vibrator to the external frame and a second suspension supporting the internal frame to the external frame.

[0009] Another object of the present invention is to provide a multi-function speaker in which a voice coil and a vibration coil are separated, and magnetic poles thereof are changed to stabilize vibration.

[0010] Another object of the present invention is to provide a multi-function speaker in which a coupling method between a voice coil and a vibration coil is freely changed to easily realize desired impedance characteristics.

[0011] Additional advantages, objects, and features of the invention will be set forth in part in the description which follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention. The objectives and other advantages of the invention may be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

[0012] To achieve these objects and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, there is provided a suspension of a multi-function speaker including: an inside portion to which a vibrator is attached to generate vibration; and an outside portion fixed to a frame to stabilize the vibration of the vibrator, thereby preventing abnormal vibration, wherein the inside portion and the outside portion of the suspension have stiffnesses different from each other.

[0013] In another aspect of the present invention, there is provided a multi-function speaker including: an internal frame supporting a diaphragm to which a voice coil is attached; a first suspension having stiffnesses different from each other at inside and outside portions thereof to vibrate the inside portion attached to a vibrator and stabilize vibration of the vibrator at the outside portion; an external frame supporting the outside portion of the first suspension, the external frame receiving the internal frame in an inner space thereof; and a second suspension elastically coupling the internal frame to the external frame to buffer a movement of the internal frame, wherein, when the vibrator is vibrated, the first suspension prevents abnormal vibration and the second suspension buffers the movement of the internal frame to stabilize an operation of the vibrator in duplicate.

[0014] In another aspect of the present invention, there is provided a multi-function speaker including: a diaphragm to which a voice coil is attached; an internal frame supporting the diaphragm; an internal magnet assy comprising an internal upper plate, an internal magnet, and an internal lower plate; a vibration coil vertically disposed with respect to the voice coil in a gap between the internal frame and the internal magnet assy; a first suspension in which the internal magnet assy is attached to an inner center thereof, the first suspension being divided into an inside portion and an outside portion with respect to a position at which the vibration coil is attached to provide stiffnesses different from each other at the inside portion and the outside portion; an external frame supporting the

first suspension, the external frame receiving the internal frame in an inner space therein; and a second suspension elastically coupling the internal frame to the external frame, wherein the voice coil and the vibration coil are disposed in a magnet circuit formed by the internal magnet assy to provide an acoustic function by vibration of the diaphragm when current flows into the voice coil and a vibration function by vibration of the internal magnet assy when current flows into the vibration coil.

[0015] The external upper plate of the external magnet assy may have a height greater than that of the internal upper plate of the internal magnet assy to increase a gap area, the outside portion of the first suspension may have stiffness greater than that of the inside portion of the first suspension, and a ratio of an inner length and an outer length may be changed to adjust a vibration characteristic.

[0016] The internal magnet assy and the external magnet assy are coupled in the same polarity to align the internal magnet assy at an exact center of a space defined by the frame due to an repulsive force between the internal magnet assy and the external magnet assy, thereby maintaining a balance, and thus preventing abnormal vibration.

[0017] When the internal magnet assy and the external magnet assy are coupled in the same polarity, the internal magnet assy may be aligned at a central position due to a repulsive force between the internal magnet assy and the external magnet assy.

[0018] It is to be understood that both the foregoing general description and the following detailed description of the present invention are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this application, illustrate embodiment(s) of the invention and together with the description serve to explain the principle of the invention. In the drawings:

[0020] FIG. 1 is a schematic view of a typical multi-function speaker;

[0021] FIG. 2 is an exploded perspective view of a multi-function speaker according to the present invention;

[0022] FIG. 3 is an assembled perspective sectional view of a multi-function speaker according to the present invention;

[0023] FIG. 4 is an assembled sectional view of a multi-function speaker according to the present invention;

[0024] FIG. 5 is a perspective view illustrating a process of assembling a multi-function speaker according to the present invention;

[0025] FIG. 6 is a perspective view of a multi-function speaker assembly according to the present invention;

[0026] FIG. 7 is a perspective sectional view of a multi-function speaker assembly according to the present invention; and

[0027] FIGS. 8 and 9 are partially sectional views explaining an operation of a multi-function speaker according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0028] The present invention and technical subjects achieved by embodiments of the present invention will be clarified through following embodiments described with reference to the accompanying drawings. The following embodiments are used only for explain the present invention while not limiting the present invention.

[0029] FIG. 2 is an exploded perspective view of a multi-function speaker according to the present invention. FIG. 2(a) is an exploded perspective view of the multi-function speaker when viewed from an upper side, and FIG. 2(b) is an exploded perspective view of the multi-function speaker when viewed from a lower side. FIG. 3 is a stereo perspective sectional view of a multi-function speaker according to the present invention, and FIG. 4 is an assembled sectional view of a multi-function speaker according to the present invention.

[0030] Referring to FIGS. 2 to 4, a multi-function speaker according to the present invention includes a front cover 102, a rear cover 104, a diaphragm 110 to which a voice coil 132 is attached, an internal frame 122 to which an external magnet assy 150 is attached to the inside thereof and a second suspension 170 is attached to the outside thereof, a vibration coil 134, an internal magnet assy 140, and an external frame 124 to which a first suspension 160 is attached to the inside thereof, which are integrally assembled. The multi-function speaker may provide an acoustic function in which the diaphragm 110 is vibrated by an electrical signal flowing into the voice coil 132 and a vibration function in which the internal magnet assy 140 is vibrated by an electrical signal flowing into the vibration coil 134 at the same time. Since the internal magnet assy 140 provides the vibration function, the internal magnet assy 140 may be referred to as a "vibrator".

[0031] Referring to FIGS. 3 and 4, according to the multi-function speaker assembly of the present invention, the first suspension 160 is divided into an inside portion and an outside portion with respect to a first protrusion 162 to which the vibration coil 134 is attached. An outside stiffness Kout from the external frame 124 to the first protrusion 162 is different from an inside stiffness Kin from the first protrusion 162 to a second protrusion 164. That is, the outside stiffness Kout may be greater than the inside stiffness Kin (Kout > Kin). Thus, the inside portion of the first suspension 160 having a low stiffness may provide a function for smoothly vertically vibrating the vibrator 140 attached to the second protrusion 164 disposed at a central portion of the first suspension 160. The outside portion of the first suspension 160 may provide a function for uniformly supporting a circumference

of the vibrator 140. As a result, it may prevent an abnormal vibration (e.g., twisted to the left and right sides) of the vibrator from occurring.

[0032] Also, in the multi-function speaker assembly of the present invention, the internal frame 122 and the external frame 124 are elastically coupled to each other by the second suspension 170 to allow the second suspension 170 to hole again the overall vibration of the second suspension 170, thereby generating more stable vibration.

[0033] Referring again to FIGS. 2 to 4, the front cover 102 has a ring shape with a wing in which the outside 120a thereof is formed of a plastic material and the inside 102b thereof is formed of a metal material. The front cover 102 is coupled to a front surface of the external frame 124. The rear cover 104 has a circular plate shape in which holes having small and large sizes are defined. The rear cover 104 is coupled to a back surface of the external frame 124 to protect internal components.

[0034] The diaphragm 110 has a circular plate shape formed of a composite material and having an outer circumference surface with a dome shape. A dome portion 110a of the outer circumference surface is supported by a hook of the internal frame 122. The voice coil 132 having a ring shape is attached to a bottom surface of the diaphragm 110.

[0035] The external frame 124 is elastically coupled to the outside of the internal frame 122 through the second suspension 170. The external magnet assy 150 including an external upper plate 152, an external magnet 154, and an external lower plate 156 is closely attached to the inside of the internal frame 122. The internal magnet assy 140 including an internal upper plate 142, an internal magnet 144, and an internal lower plate 146 is disposed at a center of a space defined by the internal frame 122 and supported by the second protrusion 164 of the first suspension 160. A gap is defined between the internal magnet assy 140 and the external magnet assy 150. The voice coil 132 and the vibration coil 134 are separately vertically disposed within the gap. At this time, the voice coil 132 is attached to the diaphragm 110, and the vibration coil 134 is attached to the first protrusion 162 of the first suspension 160.

[0036] The second suspension 170 fitted into the outside of the internal frame 122 is disposed on the hook of the external frame 124. The first suspension 160 having a dual-stiffness is coupled to a lower side of an inner surface of the external frame 124.

[0037] In the multi-function speaker of the present invention, the voice coil 132 and the vibration coil 134 are connected in series or parallel to each other to generate an electric field within a magnetic circuit according to an electrical signal applied from the outside. As shown in FIGS. 5 to 7, an actual product has a structure including a connection part 180 having a cylindrical and rectangular parallelepiped shape to connect electricity to the outside.

[0038] A process of manufacturing the multi-function speaker according to the present invention will be described now. The external magnet assy 150 is the inside of the internal frame 122, and the second suspension 170 is attached to the outside of the internal frame 122. The internal frame 122 may be integrally manufactured using inserted injection molding. The diaphragm 110 to which the voice coil 132 is attached adheres on the internal frame 122 using an UV bonding to form a first sub-assy. The external frame 124 is integrally manufactured with the first suspension 160 using the inserted injection molding. The vibration coil 134 and the internal magnet assy 140 are attached on the first suspension 160 to form a second sub-assy.

[0039] The first sub-assy is inserted into the second sub-assy, a coil is connected, and a soldering process is performed to form a third sub-assy. When the front cover 102 is coupled to the rear cover 104 as shown in FIG. 5, the multi-function speaker assembly is completed as shown in FIG. 6. FIG. 6 (a) is an assembled perspective view of the multi-function speaker when viewed from an upper side, and FIG. 6(b) is an assembled perspective view of the multi-function speaker when viewed from a lower side. Referring to FIG. 6, the multi-function speaker of the present invention is connected to an external device through an external connection terminal 188 such as a spring terminal of the connection part 180.

[0040] FIG. 7 is a perspective sectional view of a multi-function speaker assembly including the connection part 180. Referring to FIG. 7, the connection part 180 includes an connection terminal 186 for connecting the voice coil 132 to the vibration coil 134 in an inner space defined between an upper extension part 182 and a lower extension part 184. The multi-function speaker of FIG. 7 has the same configuration as that of FIG. 3 except the connection part 180. Thus, their detailed descriptions will be omitted.

[0041] An operation principal of the completely assembled multi-function speaker according to the present invention will be described in detail with reference to FIGS. 8 and 9.

[0042] Referring to FIG. 8, in the multi-function speaker according to an embodiment of the present invention, the external magnet assy 150 and the internal magnet assy 140 respectively having polarities (N and S poles) different from each other are coupled to with a gap therebetween. Here, a magnetic circuit in which a magnetic force flows from the upper plate 142 of the internal magnet assy to the lower plate 146 of the internal magnet assy via the upper plate 152 of the external magnet assy and the lower plate 156 of the external magnet assy is formed. The voice coil 132 attached to the diaphragm 110 and the vibration coil 134 attached to the first suspension 160 are disposed in the gap. The upper plate 152 of the upper plate 152 of the external magnet assy fixed to the internal frame 122 has a height greater than that of the upper plate 142 of the internal magnet assy, which is vertically moved when operated, by a distance d to increase a "gap area". Thus, a magnetic field line of the magnetic circuit

may be stable in spite of the vibration of the internal magnet assy.

[0043] In this state, when the voice coil 132 and the vibration coil 134 are connected in series or parallel to each other to apply an electrical signal from the outside through the connection part 180, an electric field is generated by current flowing into the voice coil 132 disposed within the magnetic circuit to vibrate the diaphragm 110, thereby generating sound. Also, an electric field is generated by current flowing into the vibration coil 134 disposed within the magnetic circuit to vibrate the vibrator that is the internal magnet assy 140. At this time, when the voice coil 132 and the vibration coil 134 are connected to in series, the voice coil 132 may serve as a low-frequency filter to transmit only a low frequency signal needed for the vibration to the vibration coil 134. That is, since a resonant frequency of the diaphragm 110 providing the general acoustic function is greater than that of the vibrator 140 providing the vibration function, only a signal having a lower frequency band is required during the vibration operation. Thus, when the voice coil 132 and the vibration coil 134 are connected to in series, the voice coil 132 may serve as the low frequency filter to remove noise.

[0044] In the multi-function speaker according to the present invention, the vibration is stably vibrated by the first suspension 160 having the dual stiffness. The inside portion of the first suspension 160 having a relatively low stiffness may provide a function for smoothly vertically vibrating the vibrator 140, and the outside portion of the first suspension 160 having a relatively high stiffness may provide a function for maintaining a balance of the vibration generated by the inner vibrator 140 to prevent an abnormal vibration (e.g., twisted to the left and right sides) of the vibrator from occurring.

[0045] The movements of the diaphragm 110 fixed to the internal frame 122 and the internal frame 122 are buffered again by the second suspension 170 to prevent the abnormal vibration from occurring. In addition, since the upper plate 152 of the external magnet assy has a height greater than that of the upper plate 142 of the internal magnet assy, the magnetic circuit may be stable to realize the stable vibration in spite of the vibration of the vibrator.

[0046] Furthermore, according to the present invention, a ratio of an inner length L1 and an outer length L2 of the first suspension 160 may be adequately adjusted to obtain a desired vibration characteristic. In addition, the external magnet assy 150 may be removed or modified to obtain various characteristics.

[0047] Referring to FIG. 9, in a multi-function speaker according to another embodiment of the present invention, an external magnet assy 150 and an internal magnet assy 140 having the same polarity (e.g., N and N poles) as each other may be coupled with a gap therebetween to respectively form a magnetic circuit due to the internal magnet assy 140 and a magnetic circuit due to the external magnet assy 150. That is, the first magnetic circuit due to the internal magnet assy 140 is formed from an upper plate 142 of the internal magnet assy to a lower plate 146 of the internal magnet assy via a voice coil 132 and a vibration coil 134. The second magnetic circuit due to the external magnet assy 150 is formed from an upper plate 152 of the external magnet assy to a lower plate 156 of the external magnet assy. In this structure according to another embodiment, the internal magnet assy may be aligned at an exact center of a space defined by a frame to maintain a balance, thereby preventing an abnormal vibration.

[0048] According to another embodiment of the present invention, the components for preventing the abnormal vibration in this embodiment has the same configuration and operation as those of the previously described embodiment except the magnetic circuit. Thus, their detailed descriptions will be omitted.

[0049] In the multi-function speaker according to the present invention, the inside of the first suspension may be smoothly vibrated by the first suspension in which the inside and outside thereof are stiffnesses different from each other, as well as, the outside of the first suspension is fixed to the frame to allow the vibrator to be stably vibrated, thereby prevent the abnormal vibration. Also, the second suspension in which the internal frame and the external frame are elastically coupled to each other may buffers the movement of the internal frame to stabilize the operation of the vibrator in duplicate.

[0050] Also, according to the present invention, since the external upper plate of the external magnet assy has a height greater than that of the internal upper plate of the internal magnet assy, the gap area may increase to stabilize the magnetic field line of the magnetic circuit in spite of the vibration of the internal magnet assy. In addition, the voice coil and the vibration coil may be separately operated to stabilize the operation of the vibrator.

[0051] Also, according to the present invention, the ratio of an inner length and an outer length of the first suspension may be changed, or the connection method between the vibration coil and the voice coil and the coupling features of the internal magnet assy and the external magnet assy may be adjusted to obtain various characteristics.

[0052] It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

Claims

1. A suspension of a multi-function speaker comprising:

   an inside portion to which a vibrator is attached to generate vibration; and

an outside portion fixed to a frame to stabilize the vibration of the vibrator, thereby preventing abnormal vibration,
wherein the inside portion and the outside portion of the suspension have stiffnesses different from each other.

2. A multi-function speaker comprising:

an internal frame supporting a diaphragm to which a voice coil is attached;
a first suspension having stiffnesses different from each other at inside and outside portions thereof to vibrate the inside portion attached to a vibrator and stabilize vibration of the vibrator at the outside portion;
an external frame supporting the outside portion of the first suspension, the external frame receiving the internal frame in an inner space thereof; and
a second suspension elastically coupling the internal frame to the external frame to buffer a movement of the internal frame,
wherein, when the vibrator is vibrated, the first suspension prevents abnormal vibration and the second suspension buffers the movement of the internal frame to stabilize an operation of the vibrator in duplicate.

3. A multi-function speaker comprising:

a diaphragm to which a voice coil is attached;
an internal frame supporting the diaphragm;
an internal magnet assy comprising an internal upper plate, an internal magnet, and an internal lower plate;
a vibration coil vertically disposed with respect to the voice coil in a gap between the internal frame and the internal magnet assy;
a first suspension in which the internal magnet assy is attached to an inner center thereof, the first suspension being divided into an inside portion and an outside portion with respect to a position at which the vibration coil is attached to provide stiffnesses different from each other at the inside portion and the outside portion;
an external frame supporting the first suspension, the external frame receiving the internal frame in an inner space therein; and
a second suspension elastically coupling the internal frame to the external frame,
wherein the voice coil and the vibration coil are disposed in a magnet circuit formed by the internal magnet assy to provide an acoustic function by vibration of the diaphragm when current flows into the voice coil and a vibration function by vibration of the internal magnet assy when current flows into the vibration coil.

4. The multi-function speaker of claim 3, further comprising an external magnet assy attached to the inside of the internal frame, the external magnet assy comprising an external upper plate, an external magnet, and an external lower plate,
wherein the voice coil and the vibration coil are disposed in a magnet circuit formed between the internal magnet assy and the external magnet assy to provide the acoustic function by the vibration of the diaphragm when the current flows into the voice coil and the vibration function by the vibration of the internal magnet assy when the current flows into the vibration coil.

5. The multi-function speaker of claim 4, wherein the external upper plate of the external magnet assy has a height greater than that of the internal upper plate of the internal magnet assy.

6. The multi-function speaker of claim 5, wherein the internal magnet assy and the external magnet assy are coupled in the same polarity to align the internal magnet assy at an exact center of a space defined by the frame due to a repulsive force between the internal magnet assy and the external magnet assy, thereby maintaining a balance, and thus preventing abnormal vibration.

7. The multi-function speaker of claim 4 or 5, wherein the outside portion of the first suspension has stiffness greater than that of the inside portion of the first suspension.

8. The multi-function speaker of claim 4 or 5, wherein the voice coil and the vibration coil are connected to in series or parallel to each other to receive an electrical signal from the outside through the same connection terminal.

FIG.1

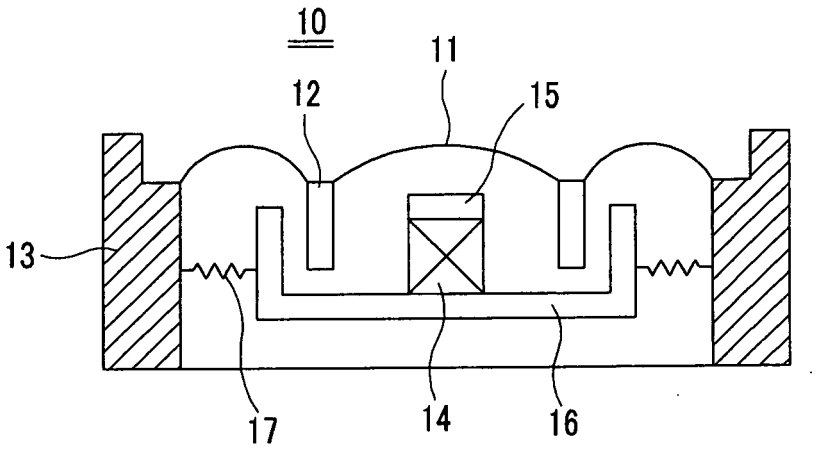


FIG.2

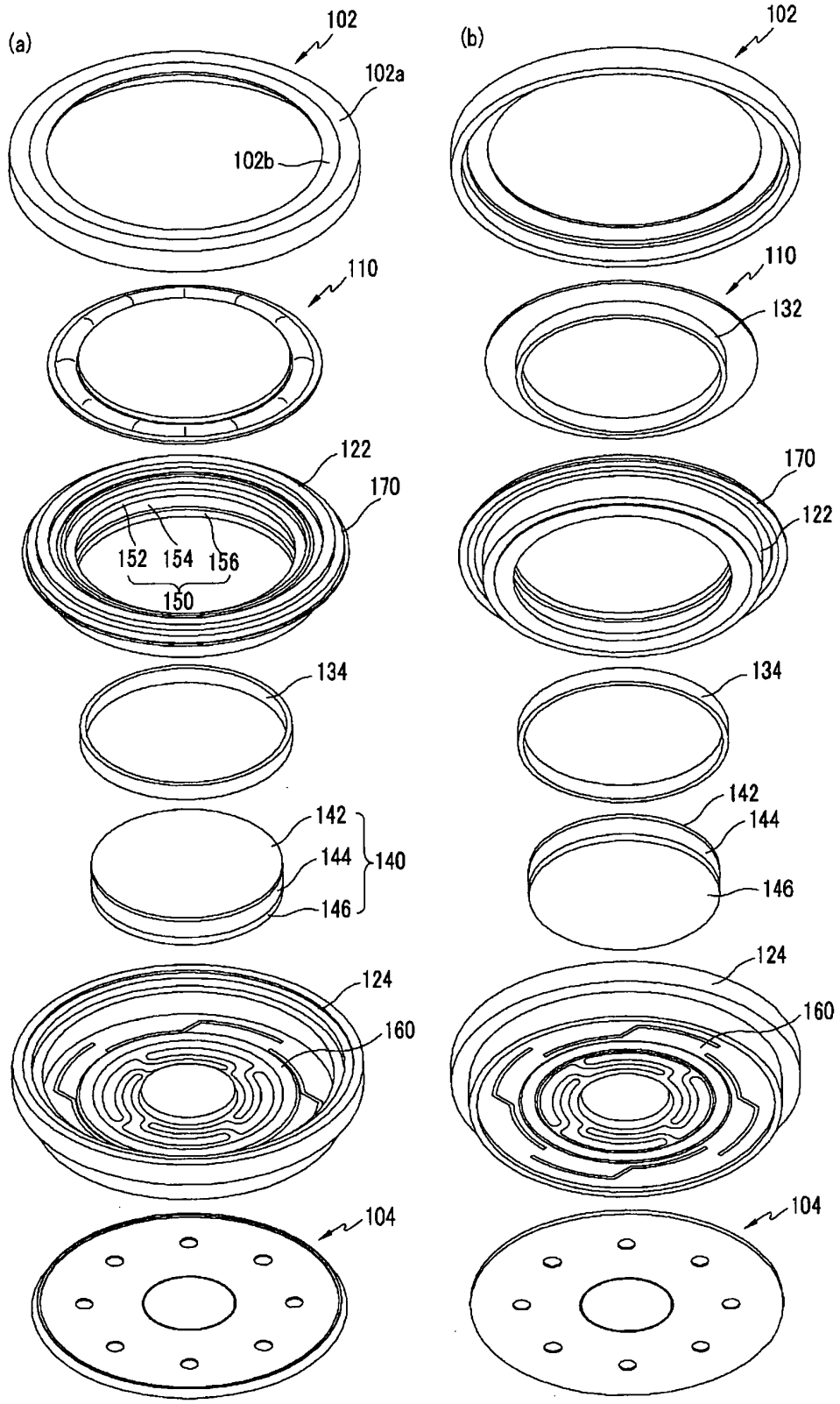

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FIG.3

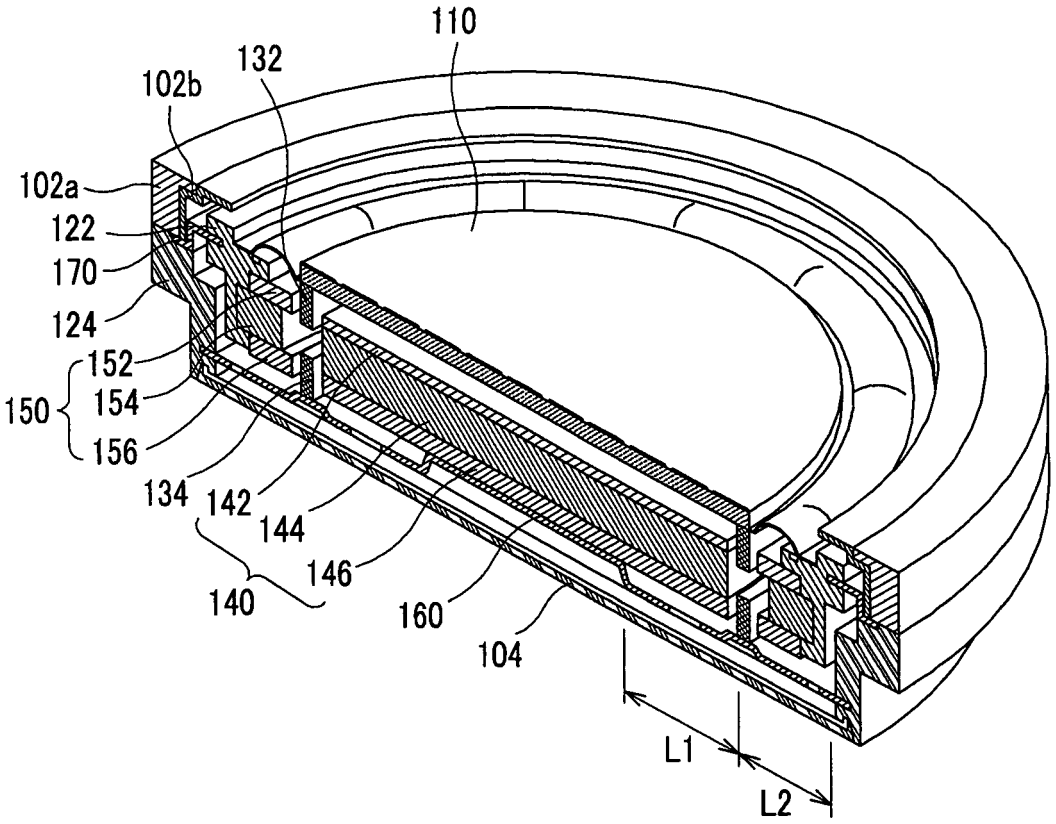
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FIG.4

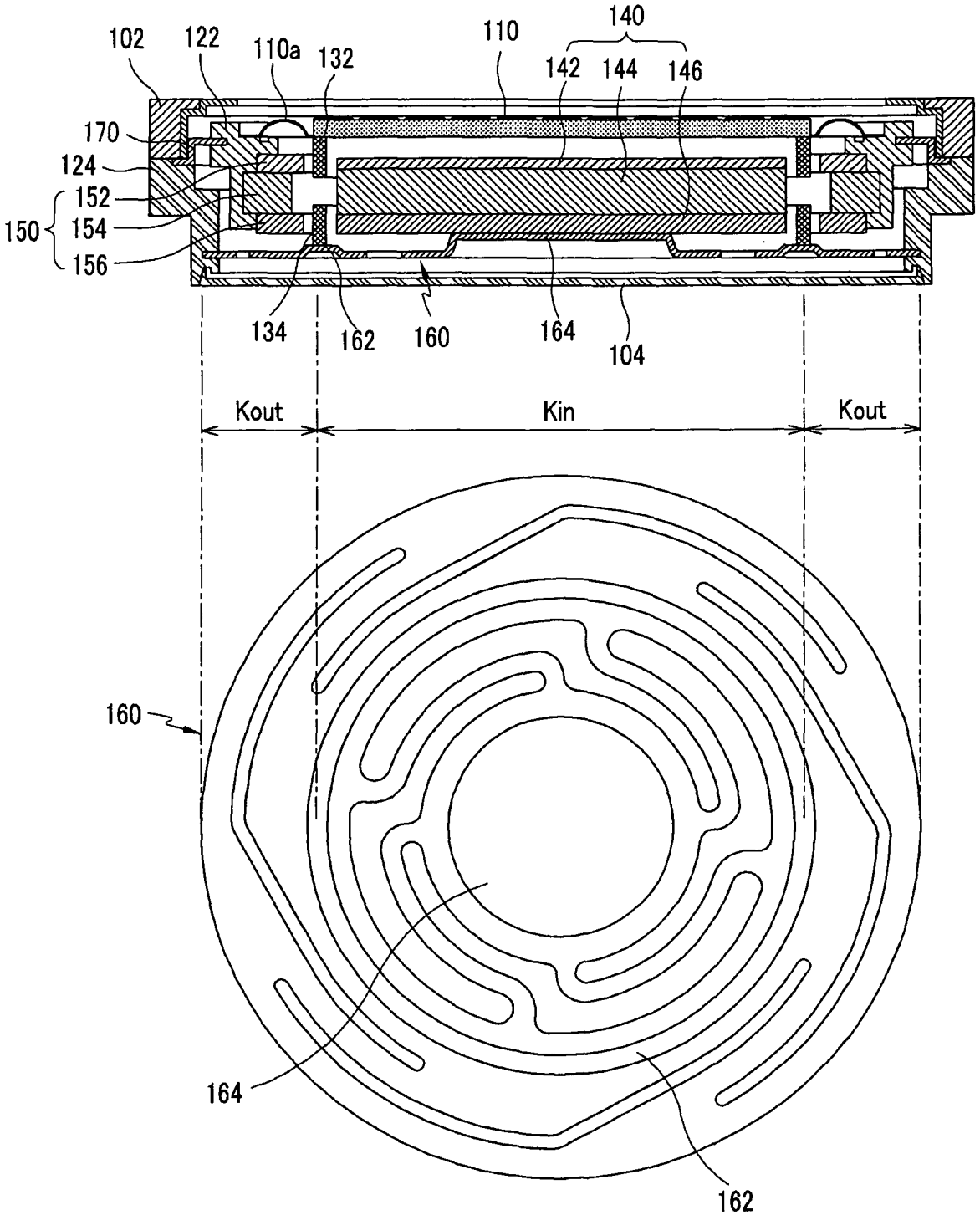
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FIG.5

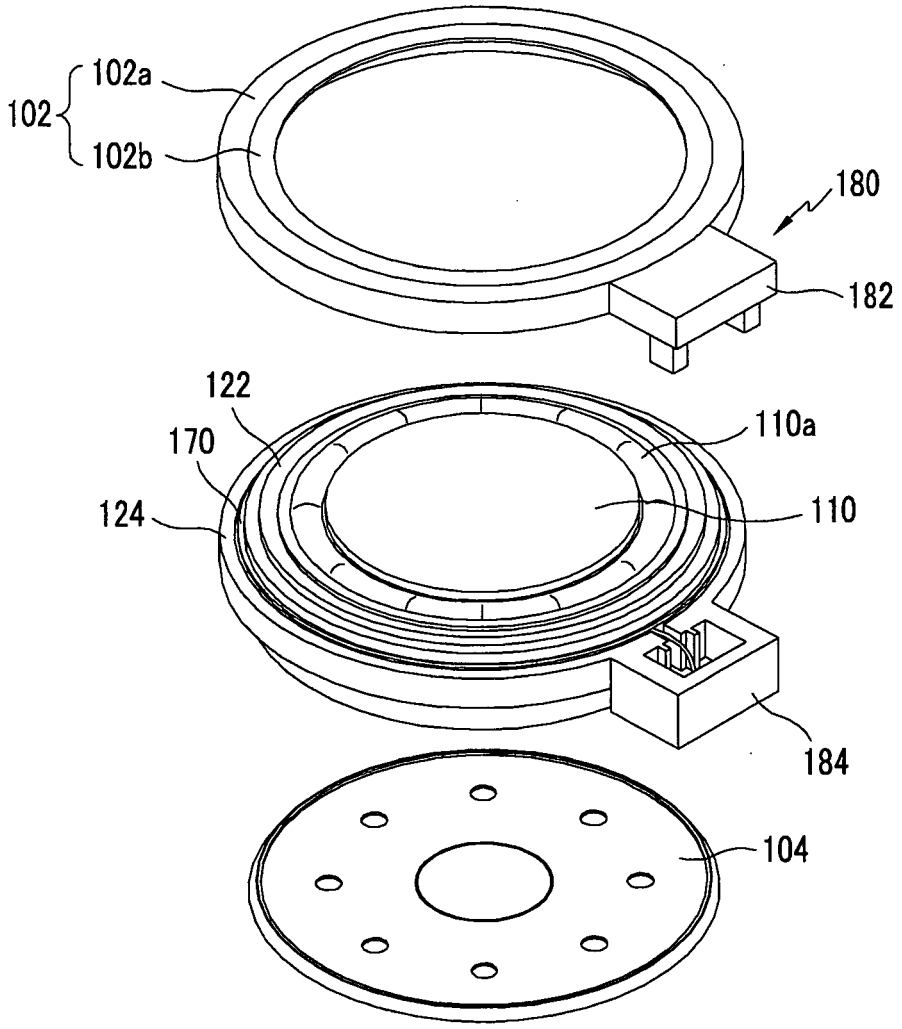

FIG.6

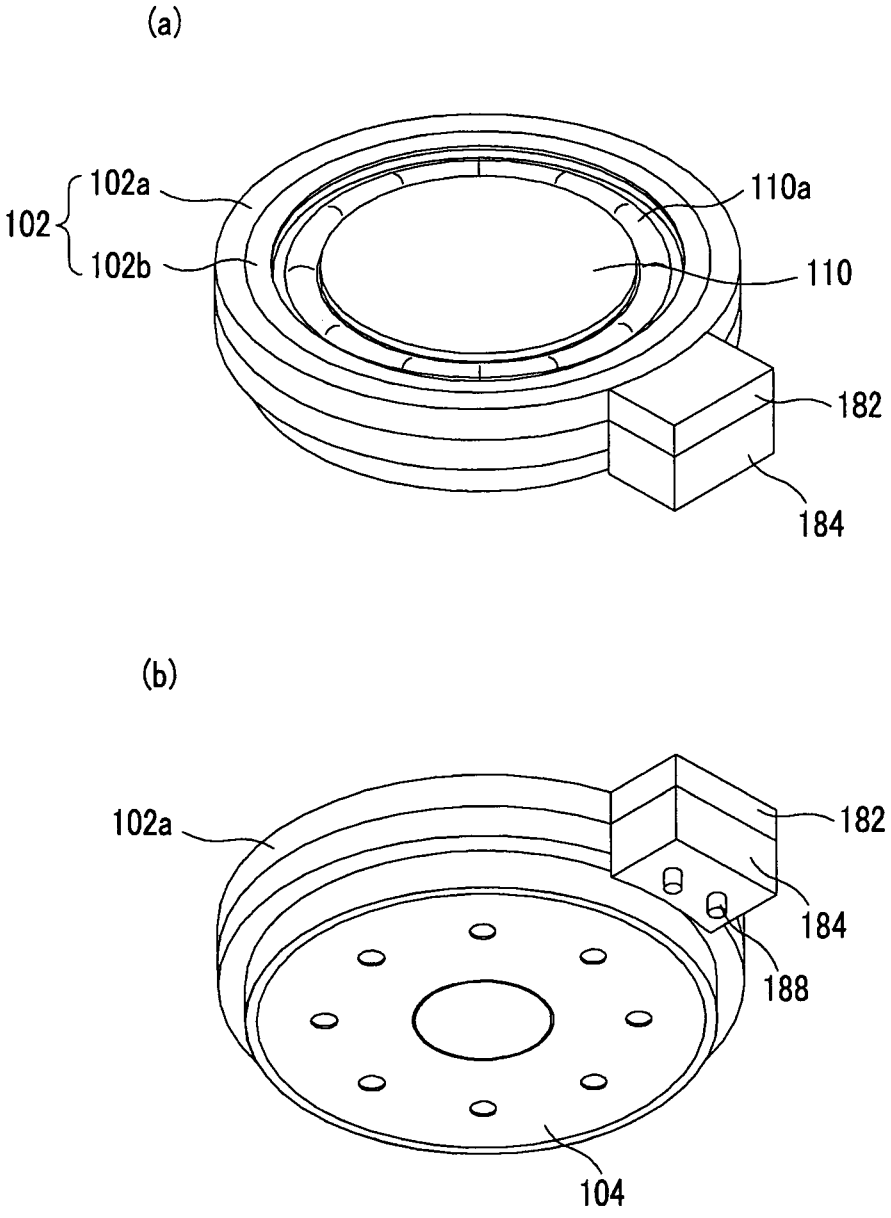

FIG.7

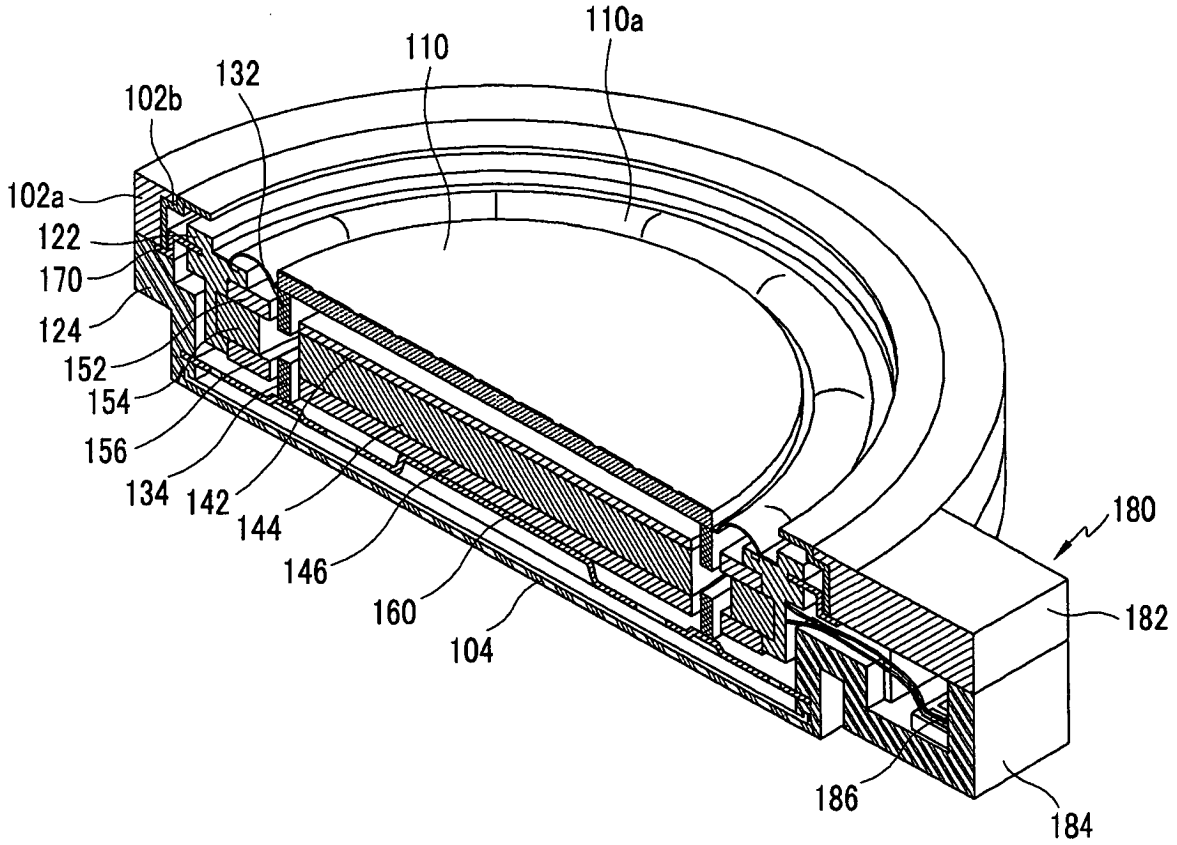
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FIG.8

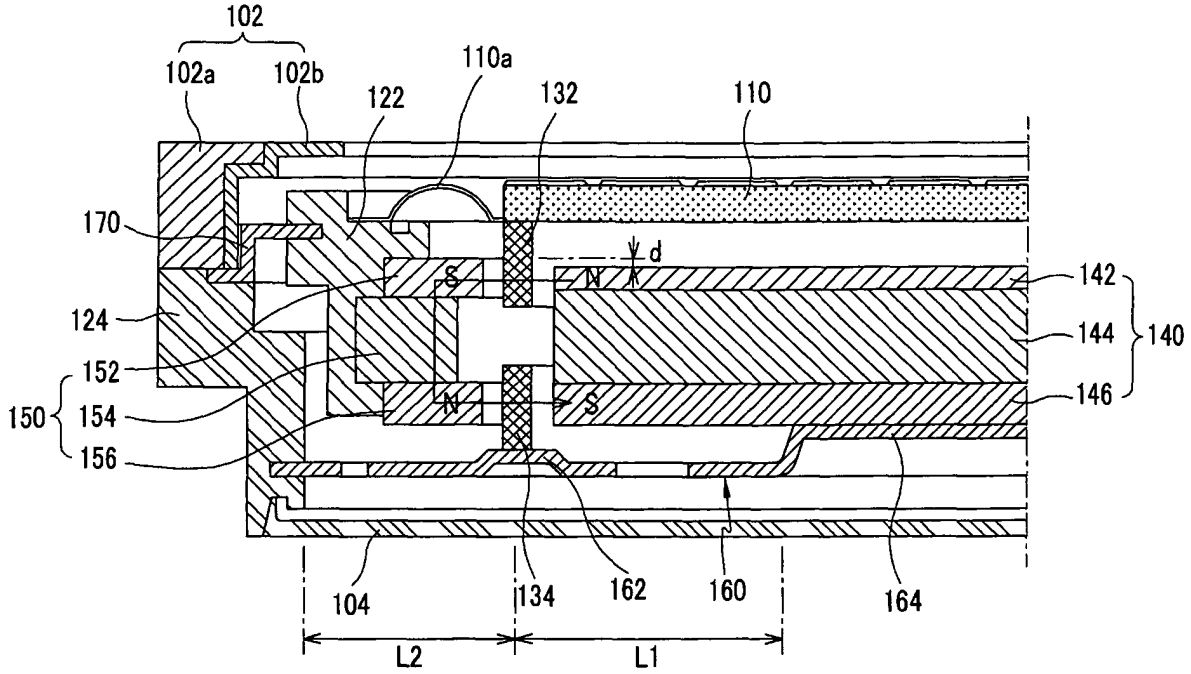
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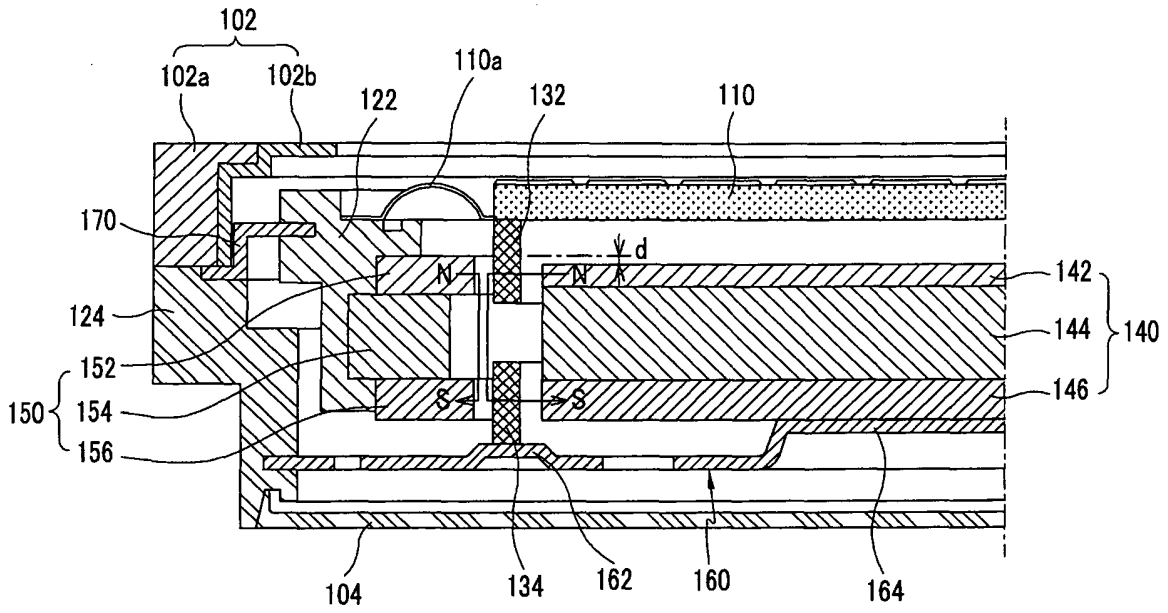
FIG.9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INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2009/001066

A. CLASSIFICATION OF SUBJECT MATTER

H04R 9/02(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC : H04R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Utility models and applications for Utility models since 1975
Japanese Utility models and applications for Utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PAJ, FPD, USPAT, eKIPASS, IEEE, YAHOO, GOOGLE , Keyword: "suspension, leaf spring, speaker"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	KR 10-2005-0044828 A (SHIN, KWANG SHIC) 13 May 2005 (See abstract, figures 5 and 6)	1 2-3
A	JP 2006-013571 A (MINEBEA KK) 12 January 2006 (See abstract, claims 1-3, pages 6-7, figure 1)	1-3
A	JP 11-215592 A (SONY CORP) 06 August 1999 (See abstract, claim 1, page 3, figure 1)	1-3
A	JP 2003-033724 A (CITIZEN ELECTRONICS CO LTD) 04 February 2003 (See abstract, paragraphs [0006]-[0012], figures 1 and 2)	1-3

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 MAY 2009 (25.05.2009)	**27 MAY 2009 (27.05.2009)**
Name and mailing address of the ISA/ Korean Intellectual Property Office Government Complex-Daejeon, 139 Seonsa-ro, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2008)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2009/001066

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 4-8
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
Since claims 4 and 5 are dependent on themselves, a person skilled in the art would be unable to determine which technical features in claims 4 and 5 are to be considered for protection. Therefore, one skilled in the art is unable to determine which technical features in claims 6 to 8 are to be considered for protection, as they refer to claims 4 or 5.

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (2)) (July 2008)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2009/001066

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
KR 10-2005-0044828 A	13.05.2005	None	
JP 2006-013571 A	12.01.2006	None	
JP 11-215592 A	06.08.1999	None	
JP 2003-033724 A	04.02.2003	None	

Form PCT/ISA/210 (patent family annex) (July 2008)